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# LINGUISTIC RELATIVITY AND
# THE LANGUAGE LEARNING PROCESS

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## PREFACE

This Memorandum presents a theoretical approach to the study of the linguistic relativity hypothesis in terms of a conception of the language-learning process based on a transformational model of language structure. The author, a consultant to The RAND Corporation, is a graduate student at the University of Wisconsin.

# LINGUISTIC RELATIVITY AND THE LANGUAGE LEARNING PROCESS

One of the major issues currently being discussed in psycho-linguistics is the linguistic relativity hypothesis, also known as the Whorfian hypothesis after its most influential exponent, the linguist Benjamin Lee Whorf. This hypothesis asserts that one's perception and conception of the world about him is shaped to a large extent by his native language, and therefore two people whose native languages differ radically in structure will form quite different conceptual models of the world. The purpose of the present paper is to attempt a rational reconstruction of the language-learning process, starting from the assumption of a transformational model of language structure, and to examine the steps in this reconstruction to discover where they tend to support and where they tend to disconfirm the linguistic relativity hypothesis.

For our model of language and conceptual structure, we shall take something that looks superficially similar to the mediation-integration model of Osgood [1] , but is in reality much closer to the recent theories of transformational grammar, such as that of Chomsky [2]. In this model language and perception are taken to be represented conceptually as sets with morpho-syntactic hierarchical organizations imposed on them, connected on their various levels by transformational correspondences. We shall refer to the hierarchical organizations of language and perception as the speaker's "syntactic network" and "conceptual network" respectively, and the set of transformational correspondences connecting them as the "semantic map" of the speaker. These entities, although abstract, are postulated to have a concrete physical representation in the brain of the speaker, just as abstract entities such as numbers, tables, and graph structures are representable by a spatial distribution of graphite particles on a piece of paper or by the polarities of ferrite cores in the memory of a digital computer. We shall elaborate on them here in such a way as to make apparent the relationship of this model to psychological learning theory as well as to modern linguistics.

The language-learning process can be conceived of as consisting of five parts. First of all, the child must learn to recognize and produce the phonemic sequences that correspond to the "elementary meaning units," or morphemes, of his language. Second, he must learn to associate each of the morphemes that have a "referential" function in the language with individuals or classes of objects, events, or attributes in his (external and internal) environment. Third, he must learn to recognize and produce combinations of these morphemes as corresponding to more complex objects, events, and attributes in his environment. Fourth, he must form class generalizations of these syntactic constructions and their denotata, so that he may be able to recognize appropriately and also to produce novel combinations of the basic units (morphemes) of his language. And fifth, he must learn the sequences of transformational rules that establish the many-one relation, in both directions, of language to experience and that enable the child to understand and produce the more complex, "derived" syntactic constructions of his language. The five types of structure formed in these five different phases of learning are symbolized in Fig. 1 on the next page.

As can be seen from Fig. 1, for each entity or class of entities in the syntactic network there is a corresponding entity or class of entities in the conceptual network, and connections in the semantic map between the two. To the continuous speech signal there corresponds the continuous stream of inputs to the sense organs. Complex "feature extractors" in each of the sense organs segment this stream into elementary perceptual units, which in the case of speech are called "phones". The next level of conceptualization, corresponding to the linguistic morpheme, is the elementary namable form (object), action, or attribute. Since various combinations of elementary perceptual units must be recognized as constituting the same form, class generalizations of elementary perceptual units will be formed in the learning process so that the path to recognition of the pattern will have a more concise internal representation and will be generalizable to new instances--in language, these are the phonemes, and in perceptions they are the perceptual invariants. This perceptual class formation
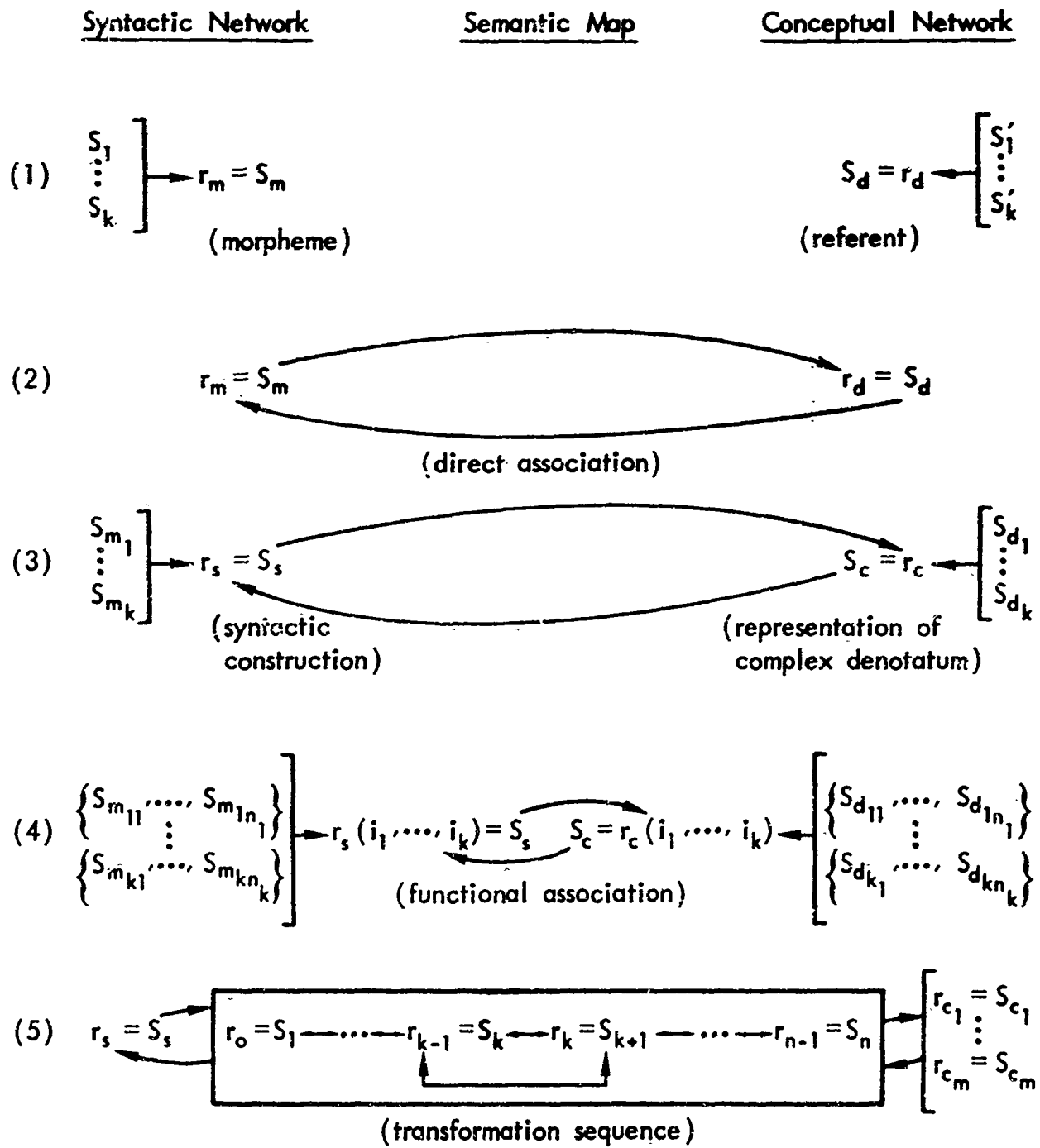
Fig.1—Symbolic representation of stages in the language-learning process

differs from the syntactic and conceptual class organization that appears on a higher level in that all stimulus groups of this class evoke the same internal response, whereas on the syntactic level each member of a class or structural type evokes a corresponding internal response that varies in a uniform way with variation over the individual members of the class. The functional difference between phonemic or perceptual classes and syntactic or conceptual classes is thus analogous to the difference between predicates and functions in mathematics--and this difference would likely appear as such in any formal mathematical model of these structures. To the various syntactic constructions of language, now, correspond the compound units of experience--objects with attributes, objects located in the environment of other objects, objects entering into actions with (or without) other objects, objects in the environment of such actions, simple and composite events, causal sequences of events, and so forth. Actions of the speaker or hearer himself are also included in this category. Correspondences between these compound units and the syntactic constructions that denote them are formed either through direct associations as in (3), functional associations as in (4), or transformational chains as in (5). Linguistic units of no greater complexity than those referred to by linguists as "kernels" or "base structures" are connected to their denotata by direct or functional associative links; more complex units are connected through transformational sequences.

In terms of our model, then, the linguistic-relativity hypothesis says that the structures formed in the syntactic network have a significant influence on the structures that are formed in the conceptual network, rather than that the influence is entirely in the opposite direction, or that the two structures develop independently and any lack of fit between them is resolved by introducing additional complexity into the semantic map. Now let us look at the different phases in the learning process and see what we can find that will either bear out or disconfirm this hypothesis.

The first phase, which must occur before any of the others, is the process of learning to recognize combinations of elementary perceptual units as constituting elementary meaningful units. Since,

presumably, no association of language and experience takes place be-
low this level, this process proceeds independently in the syntactic
network and the conceptual network. Here, discrimination of these
combinations, in terms of classifying different sets as different
meaningful units, can be accomplished only through either innate criteria
of similarity, or differential effects on motivational conditions with-
in the organism, or a combination of the two. And here combinations
of perceptual units into conceptual units will clearly have more direct
an interaction with motivational conditions than will combinations of
phonemes into morphemes, although motivational conditions may have an
effect on the latter as well, through both the self-reinforcing effects
of imitative behavior (which depends in turn on innately-based similarity
judgments) and deliberate training by other members of the linguistic
community (where reinforcement here is contingent on their more highly-
developed similarity judgments). Therefore, it is reasonable to con-
clude that, prior to the learning of any referential associations, the
child's repertoire of nonlinguistic conceptual units and his ability to
discriminate among them will be much more highly developed than his cor-
responding repertoire of elementary syntactic units (morphemes) and
ability to discriminate among them.

In the second phase of learning, the child learns referential
associations between elementary syntactic units and elementary con-
ceptual units. In this process, the child's already fairly substan-
tial ability to recognize and discriminate among different elementary
conceptual units aids him in learning to recognize and discriminate
among different elementary syntactic units, through the classical
paradigms of stimulus and response differentiation. At the same
time, and to an increasingly greater degree as the child's repertoire
of linguistic units is built up, the need to associate similar per-
ceptual stimuli with different linguistic ("naming") responses guides
the formation of his perceptual discriminations by delineating the
set of categories into which he will classify stimulus patterns. It
is on this pattern-classification aspect that most of the empirical
study concerned with the linguistic-relativity hypothesis has centered
itself, and the results conclusively confirm this obvious fact--that

the ability to classify and discriminate among patterns is governed largely by the need to learn to respond differentially to them. And where different linguistic naming responses must be learned, this requirement is certainly met--but pattern discriminations can still be learned in nonlinguistic ways as well. We can conclude from this, therefore, that differences in the referential categories imposed conventionally by different languages influence the course of development of perceptual discriminations in the child to the extent that the requirement of making differential linguistic responses to similar stimuli predominates in influence over the requirement of making differential nonlinguistic responses to similar stimuli.

With the learning of referential associations, the gateway is opened to learning new nonlinguistic "facts", or associations among objects, actions, and attributes, by experiencing their linguistic names in contiguity with one another. Ordered combinations of these names experienced in conjunction with the experience of some combination of their learned referents causes not only the learning of the ordered combinations of names themselves but also draws the child's attention to the fact that their referents occur in combination. Thus we see that, even at the most rudimentary level of syntax acquisition (the third phase in our five-phase model), the syntactic constructions of the language influence the sorts of conceptual relationships that the child learns to attend to. It does not determine these, since they can be influenced by nonlinguistic factors also. It is the fact of temporal co-occurrence, or contiguity, of the names, rather than any temporal ordering placed on them, that accounts for this linguistic influence. Therefore we should be able to predict that two languages that possess similar types of syntactic constructions and differ only in the word order within these constructions will not have differential effects on the cognitive abilities of their speakers--but two languages that differ in the types of words (as classified with respect to their referents) that may co-occur will induce differences in the types of conceptual relationships that their speakers are likely to perceive.

The fourth step in the language-learning process, as represented in our model, is the generalization of co-occurrence relations into phrase classes and the inclusion of these phrase classes in other phrase classes to build up recursive structures in the syntactic network. Here, for the first time, we have, not direct associations but functional associations. The referent of an instance of a phrase class is computed as a function of the structural types, as represented in the conceptual network, of the referents of its constituent elements; the function is related to the particular type of phrase class. (This view of language structure has been formulated most explicitly by Thompson [3].) These phrase-class generalizations will first be formed over elements whose referents have the same structural type of representation in the conceptual network--this must be so, in fact, for the corresponding functions to be computable and also generalizable to new instances. Later, when something recognized as an instance of the phrase-class type but containing a new referent word is presented, the hearer will be constrained to infer that its referent is an instance of the structural type that obtains for referents of elements in that position in the phrase, unless he is to learn a new function as corresponding to that phrase type. An experiment by Brown [4] involving the learning of non-sense words in verbal context by preschool children clearly demonstrates the effects of this process. We may thus conclude that the positions in which new words and phrases are learned in context, a feature which is language-dependent, will have a strong determining effect on the conceptual representations of the referents associated with these new words or phrases, since they will be constrained to be of the same structural type as the referents associated with elements that have been previously experienced in that position in the phrase. Thus, in English, for example, elements occurring in noun position will tend to be associated with objects, elements occurring in verb position will tend to be associated with actions or states, and elements occurring in adjective position will tend to be associated with attributes. On the other hand, these functional associations will have an effect that compensates for the lack of discrimination inherent in the basic referent categories of any language--for example, in constructions like 'dark

green', 'snow good for packing', 'probably went', etc.--and therefore
will tend to blot out the interlingual differences in perceptual dis-
crimination resulting from the second, or morpheme-referent association,
phase of language learning. However, the perceptual habits or sets
developed between the second and fourth phases of language acquisition
will presumably continue to influence the speaker's way of looking at
the world throughout the rest of his life.

The fifth, or transformational, phase of language learning is where
the process of "disengagement" of language structure from conceptual struc-
ture is achieved to the greatest extent. The learning of transformations is
the learning of equivalences of many different types of linguistic struc-
ture in terms of their images under the semantic map, as well as the learn-
ing of modes of expression for complex constructions in the conceptual net-
work. At the same time, the learning of transformations provides mappings
of similar syntactic constructions into several different types of con-
ceptual structures, and thus mitigates the restrictive effects of the
strict functional dependencies acquired in the fourth phase of language
learning. By opening up the whole range of stylistic devices available
in a language, transformations greatly widen the range of percepts and
concepts that may gain expression in that language. It is reasonable to
conclude that the restrictions imposed by language structure on the con-
ceptual abilities of the post-transformational language user are not
particularly great. However, as was mentioned above, the perceptual and
conceptual habits developed by the speaker of a language before acquiring
the full set of transformations available in his language will likely
persist throughout his adult life unless new experiences (such as the
learning of a second language) force them to change.

In summary, we may conclude from the foregoing that, under the
assumptions underlying the model of language acquisition that has been
presented here, the syntactic and semantic structure of one's native
language does indeed have an effect on the way he perceives and conceives
of the world; but that the effect is dispositional rather than deter-
minative, and poses no insuperable handicap to the adult speaker who
has fully mastered the transformational structure of his native language.

There should be no reason, then, why the ideas and concepts expressed in any language cannot be translated into any other language. The ideas and modes of expression may seem very unnatural to a speaker of the second language if their translation is rendered faithfully, but they should not remain completely incomprehensible. A faithfully rendered translation, however, might involve the use of many circumlocutions to express ideas that can be expressed "naturally" in the first language but not in the second; therefore, it is understandable that a translator will change the content of his material somewhat in order to better fit the expression patterns of the language he is translating into. (This is especially true if, as is the recommended practice, the translator is translating from a foreign language into his own native language, for he will then naturally tend to reinterpret the ideas in terms of the modes of expression that are "natural" for him in his native tongue.) Then, too, we have not taken into consideration some of the pragmatic aspects of language structure that may vary with the particular language, such as the judicious choice of alternative meanings of polysemous words and idioms in order to reflect certain attitudes and beliefs on the part of the society (for example, the use of the words 'honest' and 'virtuous', in referring to a woman, to mean "innocent of illicit sexual intercourse", or the use of 'virgin' to mean "pure" or "unadulterated" in reference to inanimate substances). An investigation of these aspects of language structure is, however, beyond the scope of the present discussion.

Obviously, the conclusions arrived at here are rather inexact and even of a somewhat speculative nature. Much further research, both theoretical and experimental, would be required to establish them on any firm basis. The underlying hope here is that theoretical investigations such as this will help to clarify the issues involved so that empirical studies can be directed toward achieving more definitive and relevant results.

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| A five-stage analysis of the language-learning process, and an investigation of whether this analysis supports or contradicts the Whorfian hypothesis of linguistic relativity. The syntactic constructions of a language influence the types of conceptual relationship that the child perceives. Words and phrases grouped together by the conventions of the language have a determining effect on conceptual representations associated with them. This effect is somewhat mitigated by the transformational phase of language learning, which opens up the full range of stylistic devices available in a language, thus extending the number of percepts and concepts that may gain expression in that language. However, earlier perceptual and conceptual habits will probably persist throughout a person's adult life unless he is forced to change by some new experience, such as the mastery of a different language. ( ) | Language and Linguistics<br>Learning<br>Semantics |